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DEVELOPMENT OF MECHANICAL TIME SUPERQUICK FUZE, T250 SERIES

The T250 is a dual-purpose 45-second mechanical time superquick (MTSQ) fuze with delayed arming. When the designation was assigned in March 1951, it was intended that the fuze be applicable to all rotating artillery ammunition of from 75 through 240 millimeters in caliber for ground targets. Development of the T250 was actively started late in 1951, and, because of the 45-second maximum time provided in the fuze, maximum effort was directed to its use with ammunition for 75-mm and 105-mm recoilless rifles, 105-mm howitzers, and 4.2-inch mortars. The fuze was designed, however, to withstand higher setback and rotational forces than were produced in these weapons.

The movement of the T250 fuze was similar to those of the fuzes of the M500 series and M501 series except that it had a 45-second maximum time setting, and it was set and calibrated in a clockwise direction. The T250 had 2-inch threads for screwing directly into matching threads in the nose of the projectile. The delayed-arming booster screwed into the base of these fuzes. On the other hand, a fuze in the M500 series screwed into the booster, which, in turn, screwed into the projectile. As in the M500-series and M501-series fuzes, centrifugal force drove the movement.

Other fuzes that had movements similar to that of the T250 included the T309 and T310 fuzes for the T315 280-mm shell. They were also calibrated and set in a clockwise direction. These fuzes had kickoff springs, they were equipped with the M28A1 (T40E1) safety adapter instead of the T356E7 booster, and they had 100-second, instead of 45-second, time ranges. . . In June 1956 the T309 and T310 were classified standard as the M522 and M523, respectively.

RELATED TIR'S

4-60	TIR 8-1-1(1)	Development of Mechanical Time Fuzes for Artillery and Mortars
9-55	TIR 8-1-1A2	MT Fuze, T310
	TIR 8-1-1A7	MT Fuze, M522 (T309E2 S2)
	TIR 8-1-1B2	MTSQ Fuze, T197E1
5-60	TIR 8-1-1B9(1)	MTSQ Fuze, T289

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Limited tests were conducted at Aberdeen Proving Ground (APG) in 1953 on the T250 and on the T289, which was identical with the T250 except that it had a 100-second timing mechanism. Both fuzes used the T35E7 booster, which had previously been tested at Picatinny Arsenal. Results of the tests at APG were unsatisfactory, but the failures were attributed to malfunctioning of the T35E7 booster. Consequently, arrangements were made in 1953 to manufacture one lot of the fuzes for service tests. Meanwhile, in engineering tests deficiencies were found in the fuze itself. Consequently, in 1954 development of the T250 model was suspended, and work was started on the T250E1 by a different contractor.

The design of the T250E1 was based upon a mainspring drive instead of centrifugal force acting on weighted main-drive segments. Since this mainspring drive could be wound with a key, it was not necessary to run the movement backwards to wind the mainspring after routine manufacturing tests to calibrate and adjust the timing. With other mainspring-drive movements it was necessary to run the movement backwards after calibration tests.

Some progress was made by the contractor on the new design, and early in 1956 ten inert fuzes were delivered to Frankford Arsenal, where they performed well in jolt, waterproofness, and spin tests. The contractor was requested to proceed with the development and produce fifty prototypes for shop and ballistic tests. The work proceeded slowly, however, and by July 1957 the fuze was still in the component-design stage. At that time it was anticipated that ballistic tests at APG would be completed by the end of 1958, but because of the shortage of funds, work progressed so slowly that by the end of 1957 the date for completion of the tests had been changed to the latter part of 1959. Later, in order to conserve funds, all work on the T250E1 fuze was suspended in favor of continued development of the T197-series fuze, which is similar in operation to the T250E1 but has a 100-second movement. The T197E2 fuze is expected to fulfill all of the requirements for which the T250E1 was being developed, and, in addition, it will meet requirements of projectiles having flight times longer than 45 seconds and shorter than 100 seconds.

Although the design of the T250 had been completed and models of it tested, development of the T250E1 was still in its early stages when work on it was suspended. Therefore, the following description covers only the T250 model.

The T250 included a 45-second timing mechanism set by rotation of the cap, a superquick impact element that functioned independently of the timing mechanism, and a delayed-arming booster. It consisted essentially of the following main assemblies:

1. A point-detonating assembly, containing an impact firing pin, SQ detonator, interrupter, and lead charge

2. A lower cap, containing a setting pin and a hammer-spring assembly. This cap rotated with respect to the body to set the desired time of functioning

3. A movement, containing a firing pin and the mechanism to release it

4. A body (containing a primer and a relay charge) inscribed with a scale to indicate the time setting

5. A ball-rotor delayed-arming booster assembly, containing a detonator, lead charge, and booster charge

The T250 fuze was assembled, stored, and transported in the unarmed condition with the mechanical time movement set at the safe position. The safety devices that kept the fuze unarmed included:

1. A pull wire inserted in the movement

2. The interrupter in the point-detonating assembly

3. A spacer post in the movement to support the hammer-spring assembly

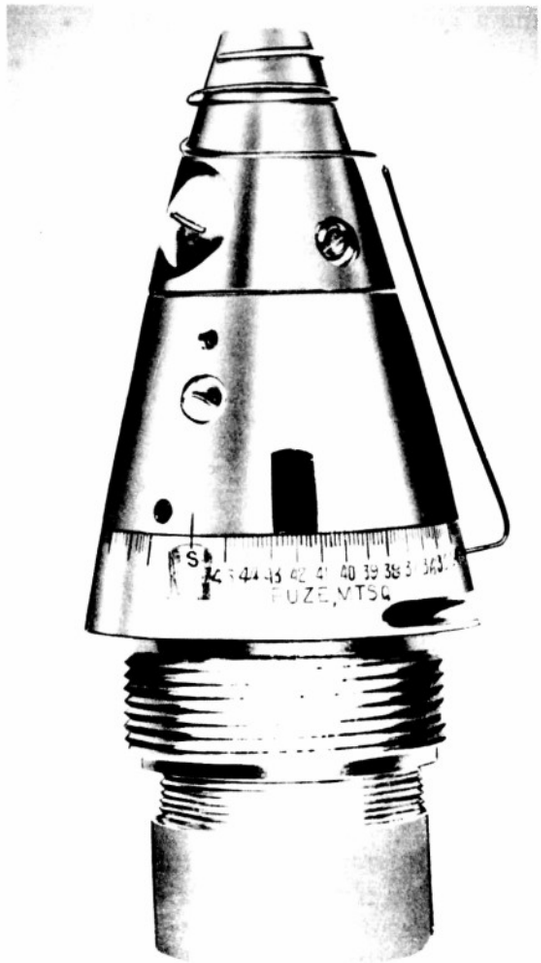
4. The safety lever of the escapement in the movement

5. The setback pin in the movement

6. Rotor detents in the booster

After the pull wire had been removed and the fuze had been screwed into the nose of a projectile, no further preparation was needed if the projectile was to be fired for SQ action only. If time action was also desired, the fuze was set for the selected time by the use of a fuze setter or a setting wrench. In either circumstance, however, the fuze remained unarmed until the projectile had been fired.

The point-detonating assembly became armed for SQ impact action when the centrifugal force produced by the spinning projectile moved the slider of the interrupter outward against its spring and cleared the flash path from the SQ detonator to the lead charge. If the fuze had been set for time, setback caused the weights of the hammer-spring assembly in the lower cap to strike and flatten the upraised lug of the timing disk, thereby releasing the disk from its setting pin so that it could be rotated by the main gear's pinion. Setback also caused the pin that had locked the firing arm and the safety lever to move toward the fuzes's base, and freed the firing arm so that it could rotate. Centrifugal force caused the safety lever of the movement to swing outward to unlock the escapement; at the same time, centrifugal force augmented by the kickoff springs put the weighted gears in motion, and they meshed with the main gear's driving pinion to set the gear train in operation.



MTSQ FUZE, T250

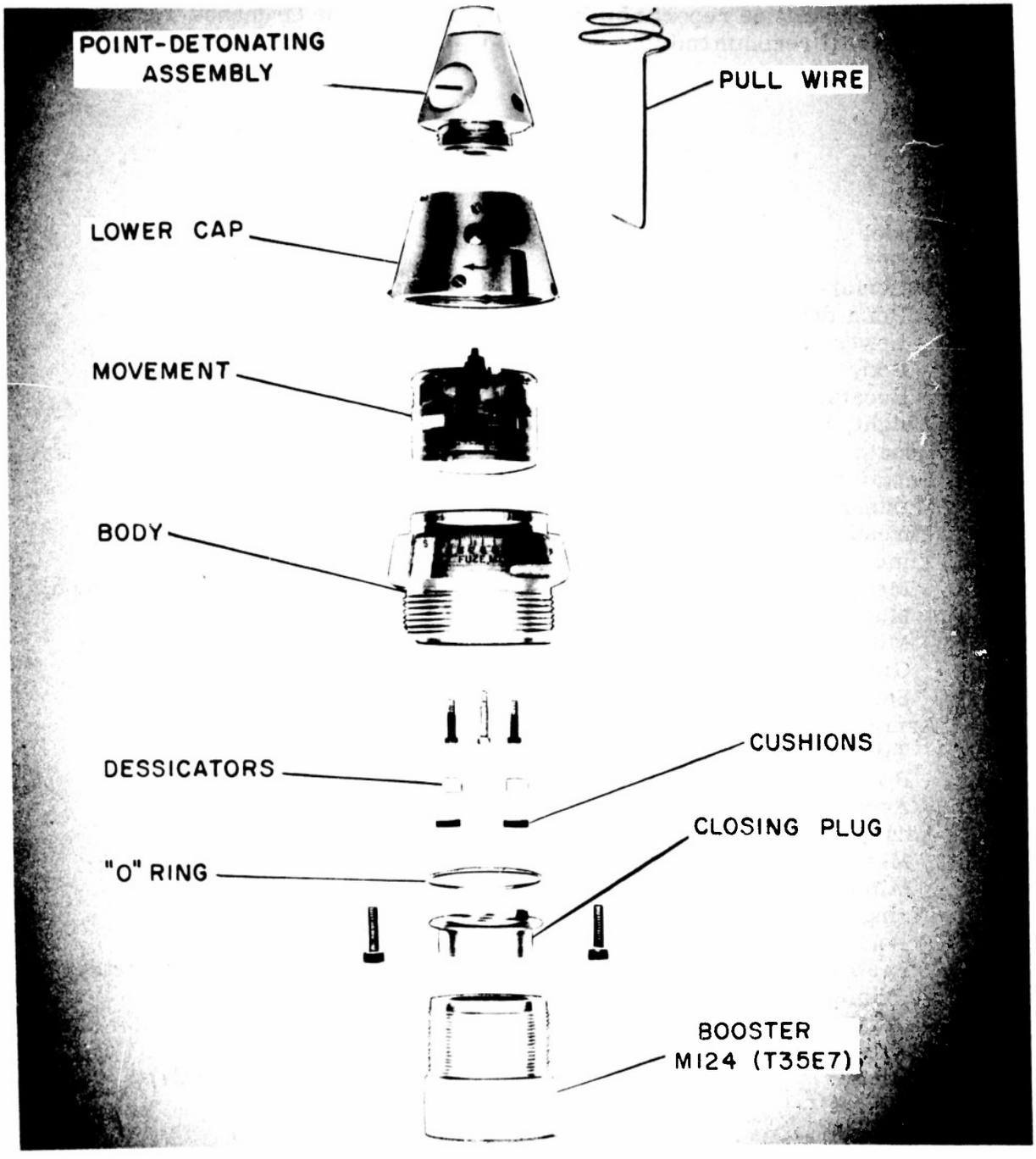
The T35E7 booster became armed only after the projectile had traveled from 40 to 100 feet from the muzzle of the weapon, the distance depending upon the weapon, muzzle velocity, and rate of spin. On firing, centrifugal force withdrew the detents from the ball rotor, which had held the detonator in an out-of-line position. Inertial forces held the rotor against its spherical seat until the projectile began to decelerate, at which time the rotor swung into a position at which the detonator was aligned with the other explosive elements of the fuze. The detonator was held in this armed position by the creep force of the rotor as the projectile continued in flight.

After a T250 fuze had been armed, it would function on impact or at the time set, whichever occurred first. The separate paths that transmitted the flash from the impact and time elements joined in the body of the fuze to form a single flash path to the delayed-arming booster.

Impact functioning took place when the nose of the fuze struck a target; the point-detonating firing pin was driven against the M18 SQ detonator, and the resultant flash, augmented by that of the lead charge, was transmitted to the M7 relay at the base of the fuze. The fuze would not normally function on graze impact.

Time functioning occurred after the timing disk had rotated to the position at which a notch in it engaged the upright projection of the firing arm and permitted the firing-arm shaft to rotate, thus releasing the safety plate from the firing pin. Thereupon, the pin was driven by a spring into the M29A1 primer, and the resultant flash was transmitted to the M7 relay at the base of the fuze.

Because the explosive elements in the booster had become armed after the projectile had traveled the requisite distance for delayed arming, detonation of the M7 relay by either the impact or the time element set off the M19A2



EXPLODED VIEW OF MTSQ FUZE, T250

detonator, lead charge, and main charge of the booster, which then detonated the explosive charge of the projectile.

A subcommittee report now being prepared for the Ordnance Technical Committee will recommend that the development of the T250-series fuze be terminated.

PRINCIPAL CHARACTERISTICS

Model	T250
Type	MTSQ
Materials	
Point detonator	aluminum
Lower cap	brass
Body	aluminum
Booster	brass and steel
Weight, with booster	2.15 lb
Length, over-all	5.95 in
Length of intrusion	2.21 in
Maximum diameter	2.4 in
Thread size	2-12 NS-1
Time-range setting	
Method	fuze setter or wrench
Maximum	45 sec
Minimum	0.8 sec
Graduations	0.2 sec
Setting torque	70-85 lb-in
Arming	
Time of arming delay	0.8 sec (approx)
Rotation required	2,000 rpm
Acceleration required	900 g
Actuation	
Method	time or impact
Minimum time functioning	0.8 sec
Firing train	
Point detonator	M18
Lead charge	1.34 grains of tetryl
Primer	M29A1
Relay	M7
Booster	
Model	M124 (T35E7)
Weight	0.60 lb
Length	1.88 in
Length of intrusion	1.88 in
Thread size, external	1.60-20 NS-2

Arming	
Distance of arming delay	40-100 ft
Rotation required	4,000 rpm
Explosive train	
Detonator	M19A2
Lead charge	3 grains of tetryl
Booster charge	350 grains of tetryl
Functioning Limits	
Fuze	
Rotation	2,600-28,500 rpm
Setback force	900-30,000 g
Booster	
Rotation	4,000-33,000 rpm
Setback force	21,000 g (max)

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